Sizing a Multi-Axis Configuration

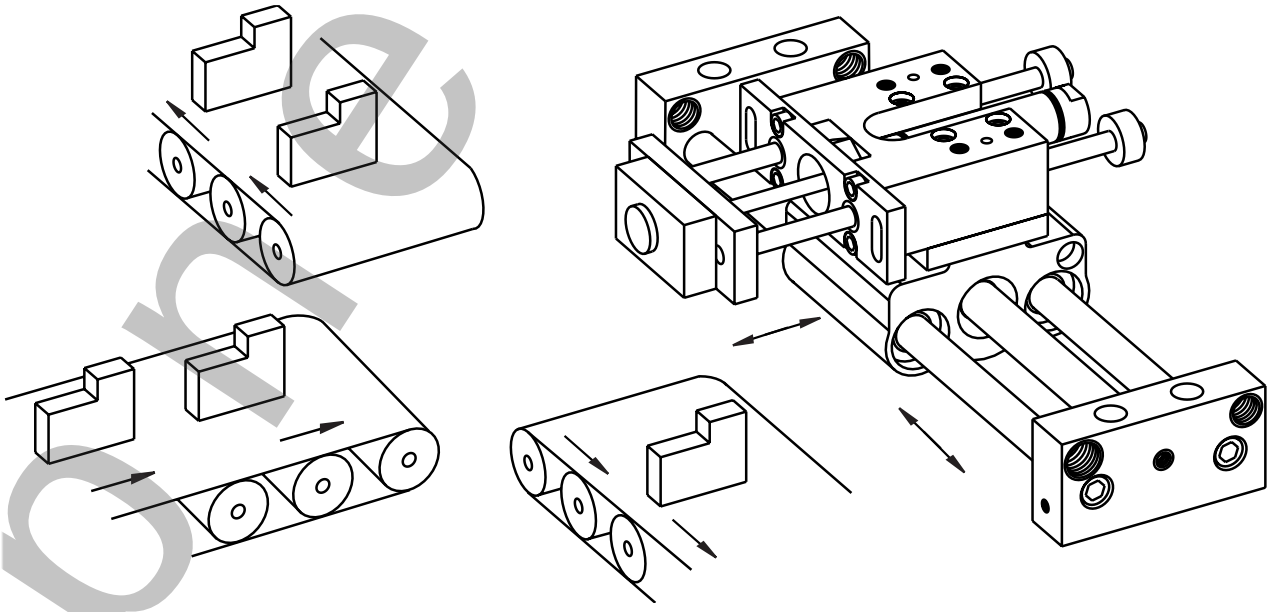
General Comments:

Selection of the actuators and the transition plates that connect them is the most important part of engineering a motion system. To begin the sizing of individual actuators into a complete motion system, you should begin at your attachment or item to move. As you select the type of Bimba product to use, be sure to reference the size and engineering data in this bulletin and in the individual product catalogs. We recommend the following method:

1. Determine the weight and center of gravity of your attachment or item to move.
2. Determine the best actuator to be connected to your attachment or item to create the desired movement.
3. Determine the size of the actuator by referencing the engineering data in this catalog and in the specific product catalog. Select the product by its load, moment, torque, and speed capability as compared to those required by your application. Remember to add in any loads, moments or torques created by any attached actuators.
4. Select the next actuator that will create movement you need.
5. Continue with steps 3 through 5 until all the motion requirements are satisfied.

In the case of a precision positioning system, the deflection of the components should be compensated for by incorporating external adjustments into the system design.

Sizing Example:



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An example of a motion system is shown on page 114 using an Ultran Slide rodless cylinder combined with a Linear Thruster by means of a Transition Plate. The application requires a product to be painted in one of two paint colors. The product coming down the conveyor is identified by a bar code which indicates the required paint color. The Linear Thruster extends to the end of its six inch stroke and picks the product by means of a vacuum system. The Linear Thruster retracts three inches before the Ultran Slide begins to move in the direction of one of the two outgoing conveyors. The slide must move eight inches in either direction from its center position to place the product on an outgoing conveyor which will send it to a specific paint booth.

To begin the sizing, we will start with the item that is to be moved. Each product weighs 5 lbs. and has flat surfaces that allow a vacuum gripper to grasp and lift it from the incoming conveyor. The center of gravity of the product is three inches from the grip surface and in the middle of the product width and height. The vacuum gripper weighs 1 lb. and has a center of gravity that is .75 inch from the tooling plate surface and in the middle of its width and height. The gripper is mounted on the center of the Linear Thruster tooling plate. A Linear Thruster with a six-inch stroke is chosen to move the product. The combined weight of the product and gripper is 6 lbs. Comparing the 6-lb. load to the maximum side load table for a standard Linear Thruster with a six-inch stroke, a 3/4 inch bore unit has the capability of 11.09 lbs. This should be sufficient to handle the 6 lb. load and take into account any light, unforeseen loads. Since the product and gripper will be centered on the tooling plate, there are no radial moments. The 3/4 inch bore Linear Thruster will be chosen as the coupled unit.

An Ultran Slide was chosen to move the Linear Thruster, vacuum gripper and product into position on an outgoing conveyor. The 3/4 inch bore Linear Thruster will be fastened to the center of the Ultran Slide carriage by means of a Transition Plate. The Ultran Slide must carry the load of the Transition Plate (0.20 lb.), Linear Thruster (2.82 lbs.), the gripper (1 lb.), and the product (5 lbs.) The total weight the Ultran Slide will move is 9.02 lbs. Comparing this to the maximum allowable radial loads for 16-inch stroke Ultran Slides, a 3/4 inch bore unit can carry approximately a 20-lb. load. The Linear Thruster is fully extended when it picks the product from the incoming conveyor, then retracts three inches before the Ultran begins to move toward an out-going conveyor. In this case, the dynamic side loading conditions on the Ultran Slide will be determined when the Linear Thruster has retracted three inches (see drawing on page 114). Since the Linear Thruster has retracted to half of its stroke length, the guide shafts are extending the same amount from each side of the Linear Thruster body. In this case there is no side load because of the guide rods. The actual side load created by the product, gripper, and Linear Thruster are found by rearranging and solving the equation found on page 61 and then comparing the result to the 20 lb. limit.

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(Calculations for page 98 example)

Side Load = ΣActual Load* [2* [(Y_1/Z+ 1]]

Actual Loads: product - 5 lbs.
gripper - 1 lb.
Linear Thruster tooling plate - .40 lb.

Side Load = 5 lbs. * [2* [(8.25 in./2.518 in.) + 1]] +
1 lb. * [2* [(4.50 in./2.518 in.) + 1]] +
.40 lb. * [2* [(3.56 in./2.518 in.) + 1]]

Side Load 3/4" bore = 50.25 lbs.

This side load is greater than the 20-lb. maximum for a side loading condition on a 3/4 bore Ultran Slide. The next larger Ultran Slide, 1-1/16" inch bore, has a side load capability of approximately 55 lbs. This Slide will be reviewed for the side load condition using the equation above.

Side Load1-1/16 bore = 42.48 lbs.

This side load is within the capability of an 1-1/16 inch bore Ultran Slide and this unit will be chosen as the base unit.

Other considerations in choosing a model include:

1. The need for a Hall Effect switch that will signal a controller when the Linear Thruster has retracted three inches. Also, external bumpers will be used to soften the impact at end-of-stroke.
2. Hall Effect Switches will be used for end-of-stroke and mid-stroke signalling on the Ultran Slide rodless cylinder.
3. Dowel pins will be used with the Transition Plate.

Thus, the products selected will be:

Linear Thruster	T-046-EB2MD
Ultran Slide rodless cylinder	USS-0916-TD
Transition Plate	TPU09-T04PD